

The Impacts of Digital Technologies on Remote and Hybrid Work: Psychological and Performance Outcomes for Knowledge Workers — A Systematic Review and Meta-Analysis



Amanullah ^{1*}, A K M Abu Zafor Shakil ², Md Miraj Hossen Khan ³

Abstract

The pandemic did more than relocate where knowledge workers sat while they worked — it reshaped, in ways still being untangled, how they experience autonomy, connection, and stress. This review set out to synthesize the psychological and performance consequences of remote and hybrid arrangements, an evidence base that has grown substantially but remains fragmented across sectors and disciplines. Following PRISMA 2020 guidelines, we searched five databases — PubMed, Scopus, Web of Science, PsycINFO, and Google Scholar — for studies published between 2000 and 2025. After screening 1,842 records across three stages, 12 studies met eligibility criteria and were retained. Data were pooled using random-effects meta-analytic models to account for the considerable heterogeneity across populations, sectors, and outcome measures; heterogeneity was quantified using I^2 , and publication bias was assessed through funnel plots and Egger's test. Moderate remote work was consistently linked to higher autonomy, engagement, and satisfaction, whereas more intensive or fully remote arrangements tended to elevate technostress, loneliness, and role ambiguity. Hybrid arrangements appeared to occupy a kind of middle ground — tempering the stress associated with full remote work while largely

preserving engagement. Organizational support, e-leadership, and adaptive technology consistently emerged as protective factors, though their influence varied meaningfully by sector, age, gender, and neurodivergent status. Taken as a whole, the evidence suggests hybrid work is not simply a pandemic-era compromise but a genuinely adaptive model — one that, when paired with thoughtful leadership and structural support, can enhance both well-being and performance for knowledge workers navigating an evolving post-pandemic workplace.

Keywords

Remote work, hybrid work, knowledge workers, technostress, job autonomy, e-leadership, psychological well-being, work engagement, systematic review, meta-analysis

1. Introduction

Something shifted in how knowledge workers relate to their jobs when the COVID-19 pandemic forced offices to empty out almost overnight. What had been, for most organizations, a fringe experiment — a handful of remote-

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friendly policies, a few flexible Fridays — became, almost by necessity, the default way of working (Lund et al., 2021; Karakitsiou et al., 2025). And it stuck. Even now, years removed from the initial disruption, hybrid arrangements remain woven into how information-based work gets done. Knowledge workers, broadly understood as those whose labor centers on creating, interpreting, and moving information rather than producing physical goods, did not experience this transition uniformly, nor simply. For some, the change was liberating; for others, corrosive. Perhaps the fairest way to put it is that remote work turned out to be a double-edged proposition — it offered flexibility, autonomy, and a welcome escape from the daily commute, but it also opened the door to a set of psychological strains that researchers are still working to fully map (De Smet et al., 2021; Cook, 2021). By some estimates, over half of employees in sectors like technology, finance, and communications shifted to remote arrangements during the pandemic's height, and unlike many pandemic-era changes, this one has proven durable — hybrid work has settled in as something closer to the "new normal" than a temporary accommodation (Lund et al., 2021). Around the same time, a related phenomenon began attracting attention from both scholars and business commentators: the so-called "Great Resignation," or "Great Attrition," in which employees left jobs in search of something better — more meaning, more balance, more control over their own time (Cook, 2021; De Smet et al., 2021). The scale of this movement in the United States alone was striking; in the final months of 2021, roughly 4.53 million people voluntarily walked away from their positions (Cook, 2021).

To make sense of what was happening beneath these numbers, it helps to start with technostress — a term that captures the fatigue, anxiety, and general wear that comes from being perpetually plugged into digital work tools (McGovern, 2021; Shamsi et al., 2021). Two of its more specific forms turn up again and again in the literature: techno-overload, the sense of being pushed to move faster and juggle more than an office environment would ever demand, and techno-invasion, in which the boundary between "at work" and "at home" simply dissolves because everyone is expected to be reachable, always (Dewe & Cooper, 2017; Marino & Capone, 2021). The numbers here are sobering. During lockdown periods, something like 71% of knowledge workers reported burnout — a figure compounded by poor sleep, unclear role expectations, and what researchers have started

calling digital presenteeism, or the habit of logging on and working through illness because the laptop is right there (Love, 2021; Harkiolakis & Komodromos, 2023). Loneliness compounds all of this. It isn't just an unpleasant feeling; it actively drains what some scholars call mental capital, the reserve of cognitive and emotional resources a person needs to function well (Mäkinen et al., 2021; Hughes et al., 2004). When people work remotely without adequate social contact, their sense of connectedness frays, and that, in turn, chips away at broader well-being — a pattern that points toward the need for organizations to deliberately build in social support rather than assume it will happen on its own (Babapour Chafi et al., 2022; Ferrara et al., 2022).

One useful lens for pulling these threads together is the Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2007), which essentially argues that job demands — heavy digital workloads, ambiguous roles, the expectation of constant availability — become harmful only when resources aren't there to offset them. Autonomy is one of the more powerful resources in this equation. When employees can shape their own schedules and workflows, satisfaction tends to follow (Beckel & Fisher, 2022; Gajendran & Harrison, 2007). Interestingly, the relationship between how much someone works remotely and how they feel about it isn't linear — it curves. Engagement and satisfaction seem to peak around a moderate dose of remote work, something in the neighborhood of two days a week, while going fully remote tends to erode trust and collaboration with colleagues and managers over time (Golden & Veiga, 2005; Juchnowicz & Kinowska, 2021). Employees who manage this well tend to draw firm lines — physical, temporal, behavioral — between their work life and home life, rather than letting the two bleed into one another (Basile & Beauregard, 2016).

Technology adoption matters here too, and the Technology Acceptance Model (TAM) offers a way to think about why some employees adapt smoothly while others struggle (Davis, 1989; Shamsi et al., 2021). When digital tools feel genuinely useful — when they make collaboration easier rather than harder — workers report less stress and more satisfaction (Shamsi et al., 2021; Alkish et al., 2025). More specialized innovations, such as human augmentation technologies and Human Digital Healthcare Engineering systems, are beginning to show promise in high-isolation contexts like offshore and

seafaring work, where real-time health monitoring can substitute for the in-person oversight that simply isn't possible (Ho et al., 2022; Cui et al., 2025; Paik, 2024). For neurodivergent employees, remote arrangements can serve a somewhat different purpose — reducing sensory overload and offering communication channels that feel more manageable, which in turn supports both comfort and performance (Tomczak & Ziemiaski, 2023).

Leadership, too, had to adapt. E-leadership — leading through screens rather than hallway conversations — has become essential to keeping hybrid teams functional and engaged (Alkhayyal & Bajaba, 2023; Roman et al., 2019). The leaders who do this well tend to build trust digitally, communicate clearly online, and cultivate what's been termed e-work self-efficacy: employees' confidence in handling digital tasks and relationships without a manager physically present (Alkhayyal & Bajaba, 2023). In healthcare settings especially, adaptable leadership and consistent communication appear to shape how well employees fare emotionally under hybrid conditions (Oleksa-Marewska & Tokar, 2022). An organizational culture that treats new technology as an opportunity rather than a threat seems to buffer against some of digitalization's harsher effects (Alkish et al., 2025).

None of this plays out evenly across the workforce, either. Younger workers — those under 25, in particular — often struggle more, partly because they've had less chance to build the informal mentoring relationships and social networks that cushion stress (Popovac et al., 2025). Mid-career employees, by contrast, often report the opposite: lower stress, better balance (Popovac et al., 2025). Women, meanwhile, continue to shoulder a disproportionate share of role conflict and domestic responsibility, which compounds the psychological toll of remote arrangements (Beckel & Fisher, 2022; Shockley et al., 2021; Oleksa-Marewska & Tokar, 2022), and dual-earner households without reliable childcare face particular strain (Shockley et al., 2021). These disparities make a strong case for policies like the legal "right to disconnect," alongside deliberate efforts to distribute workload fairly and protect psychological safety across the board (Marino & Capone, 2021; Harkiolakis & Komodromos, 2023).

Taken together, the meta-analytic evidence gathered across these studies draws a fairly consistent picture: remote work intensity, autonomy, and technostress are all measurably linked to outcomes like stress, engagement,

and self-rated mental health (Mäkinen et al., 2021; Shamsi et al., 2021; Alkhayyal & Bajaba, 2023; Alkish et al., 2025; Popovac et al., 2025), and odds-ratio analyses suggest that moderate remote work paired with thoughtful digital tools tends to improve health outcomes — while excessive remote intensity or weak managerial support tends to do the opposite (Juchnowicz, 2021; Ferrara et al., 2022; Alkish et al., 2025). What emerges, then, is less a simple verdict on remote work than a call for balance: structural arrangements and individual coping strategies have to work in tandem if organizations hope to get this right. The chapters that follow attempt to unpack exactly how — drawing on the JD-R model and TAM as guiding frameworks to understand what sustains both well-being and performance in this still-evolving landscape of knowledge work (Bakker & Demerouti, 2007; Davis, 1989).

2. Materials and Methods

2.1. Protocol and Reporting Standards

Before describing what we did, it's worth being upfront about how we approached the review as a whole. We followed the PRISMA 2020 statement throughout — not as an afterthought applied at the writing stage, but as a structuring framework from the earliest planning of the search strategy through to the final synthesis (Figure 1). This meant that decisions about eligibility, screening, and data extraction were specified in advance rather than adjusted opportunistically once we saw what the literature looked like. We should note, too, that heterogeneity in outcome reporting across the included studies — which we discuss at length in the Results — made some post hoc judgment calls unavoidable; we flag these where relevant rather than pretending the process was more mechanical than it actually was.

2.2. Literature Search Strategy

The search itself was built to be broad enough to capture the full arc of remote and hybrid work research, spanning both the pre-pandemic literature (where telework was already an established, if narrower, area of inquiry) and the substantially larger body of post-2020 work. We searched five databases — PubMed, Scopus, Web of Science, PsycINFO, and Google Scholar — reasoning that no single database indexes management, occupational health, and psychology literature comprehensively enough on its own. The date range ran from January 2000 to December 2025.

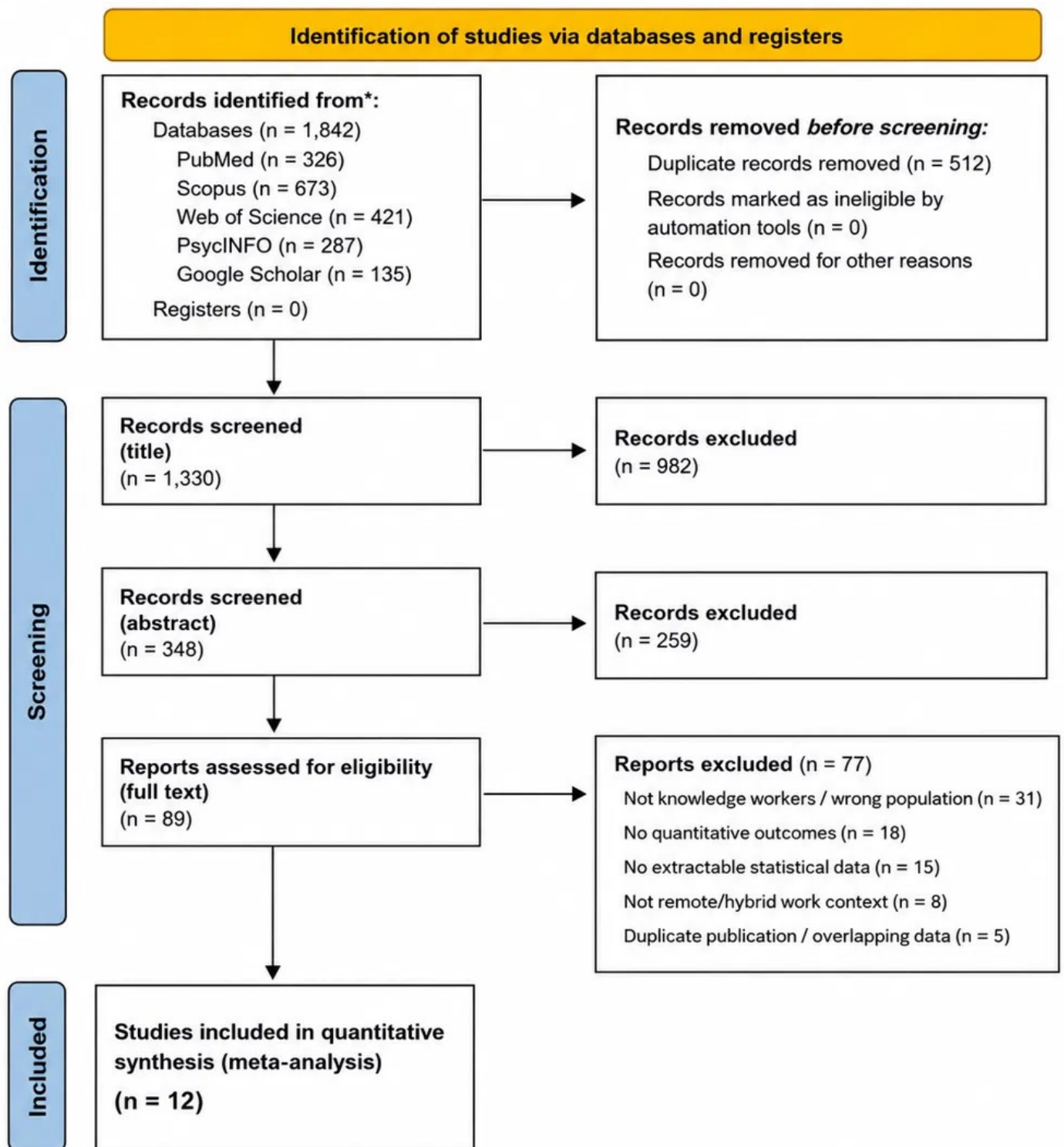


Figure 1: PRISMA 2020 Flow Diagram Depicting the Identification, Screening, and Inclusion of Studies for the Systematic Review on Remote and Hybrid Work Among Knowledge Workers. This flow diagram illustrates the study selection process across four stages — identification, screening, eligibility assessment, and inclusion — beginning with 1,842 records identified through database searching and citation tracking, and concluding with 12 studies retained for qualitative synthesis and meta-analysis. Reasons for exclusion at each stage (e.g., non-knowledge-worker populations, qualitative-only design, insufficient statistical reporting) are indicated where applicable, consistent with PRISMA 2020 reporting standards.

Search terms were combined using standard Boolean logic. Roughly, the core string looked like: ("remote work" OR "telework" OR "hybrid work") AND ("knowledge workers") AND ("job performance" OR "psychological well-being" OR "technostress" OR "work engagement" OR "job autonomy" OR "e-leadership"). Truncation and synonym variants were applied where database syntax allowed it — for instance, "telecommut*" to capture telecommuting alongside telework. We also hand-searched the reference lists of key papers already known to be central to this literature (e.g., foundational JD-R and TAM work; Bakker & Demerouti, 2007; Davis, 1989), a step that turned up a small number of studies the database searches alone had missed. This citation-tracking approach is admittedly less systematic than the database searches proper, but it's a fairly standard safeguard against the blind spots that even well-constructed search strings tend to have. This process yielded 842 records in total. From there, screening proceeded in three stages — title screening, abstract screening, and full-text assessment — with each stage progressively narrowing the pool based on the eligibility criteria described below.

2.3. Eligibility Criteria

Following a fairly standard PICOS-style framework, we included studies if they met three conditions. First, the population had to consist of knowledge workers — individuals whose jobs center on the creation, interpretation, or transmission of information — engaged in either remote or hybrid arrangements; studies focused primarily on manual, frontline, or non-knowledge-based occupations were excluded, since the psychological demands of those roles differ enough that pooling them would have muddled the comparison. Second, studies needed to report quantitative outcomes tied to psychological well-being, mental health, job performance, or productivity; purely qualitative or conceptual papers, however insightful, were set aside for this reason. Third, and this proved to be the most limiting criterion in practice, studies had to provide extractable statistical data — effect sizes, regression coefficients, odds ratios, or enough raw information to derive one of these.

Where standard errors weren't explicitly reported, we calculated them from available t-values or confidence intervals using standard conversion formulas, following the approach outlined by Borenstein et al. (2021); these derived values are flagged with an asterisk in Tables 1 and 2 so that readers can distinguish original from

computed figures.

After duplicate removal and the three-stage screening process, 12 studies met full eligibility and were retained for data extraction and meta-analysis. Two reviewers conducted screening independently at each stage, and disagreements — there weren't many, but a handful did arise, mostly at the full-text stage over whether a study's sample genuinely qualified as "knowledge workers" — were resolved through discussion, with a third reviewer consulted where consensus wasn't reached.

2.4. Data Extraction and Coding

Data extraction used a standardized form built specifically for this review, piloted on a small subset of studies before full deployment to check that the categories made sense across the diversity of designs we were dealing with. For each included study, we recorded author(s) and year, sample size, population characteristics, the specific type of work arrangement under study (remote, hybrid, or office-based comparator), the outcome measure(s) used, the reported effect size metric, and precision indicators — standard errors and 95% confidence intervals where available. Outcomes were sorted into four broad domains: (1) psychological well-being, covering constructs like stress, burnout, and general mental health; (2) social and relational outcomes, such as loneliness and team cohesion; (3) work engagement and performance; and (4) cognitive and productivity measures. We also coded study design (cross-sectional, longitudinal, or quasi-experimental), the specific measurement instruments used, and any control variables reported — age, gender, occupation, and telework intensity came up most consistently.

As with the screening stage, two researchers extracted data independently, and results were cross-checked; discrepancies were resolved through discussion or, failing that, third-party adjudication. This dual-extraction approach takes longer, admittedly, but it's a reasonably well-established safeguard against transcription errors and idiosyncratic coding decisions that can otherwise creep into meta-analytic datasets.

2.5. Risk of Bias and Quality Assessment

Quality appraisal drew on two complementary tools, selected to match the range of designs in our sample: a modified Newcastle-Ottawa Scale for the observational studies, which made up the bulk of the dataset, and the

Cochrane Risk of Bias tool for the smaller number of experimental or quasi-experimental designs (Higgins et al., 2011). Assessment considered sample representativeness, the appropriateness of the study design for its stated research question, the validity and reliability of measurement instruments, completeness of data reporting, and how well confounding variables were controlled for.

Each study received a quality rating on a low-to-high scale, and studies falling toward the lower end were flagged for closer scrutiny in the sensitivity analyses described below, rather than excluded outright — a decision we made deliberately, since dropping lower-quality studies entirely risked losing some of the sectoral and demographic diversity that gives this review its breadth. Publication bias was assessed through funnel plot visualization and Egger's regression test for intercept asymmetry, a fairly standard combination for detecting the kind of small-study effects that can otherwise inflate pooled estimates. Where a study showed an outlying effect size relative to the rest of the pool, we examined it individually for methodological anomalies and, in a small number of cases, excluded it from the pooled analysis to avoid distorting the overall estimate.

2.6. Statistical Analysis and Meta-Analytic Procedures

For the quantitative synthesis, effect size metrics — standardized beta coefficients, odds ratios, and related indices — were converted to a common scale where necessary so that studies using different statistical conventions could be meaningfully compared. Given the substantial variation in populations, sectors, and measurement approaches across the included studies, we used random-effects models throughout rather than fixed-effects models, on the assumption that the "true" effect almost certainly varies across contexts rather than representing a single underlying value that studies are all estimating with error.

Heterogeneity was quantified using the I^2 statistic, interpreted according to conventional thresholds of roughly 25%, 50%, and 75% as markers of low, moderate, and high heterogeneity, respectively (Higgins et al., 2003). Where heterogeneity was substantial — as it was for several of our pooled outcomes — we conducted subgroup analyses to explore whether demographic factors (age, gender, neurodivergent status), work intensity (fully remote versus hybrid), or sector

(technology, healthcare, finance) helped explain the variation. Sensitivity analyses used a leave-one-out approach, sequentially excluding each study to check whether any single study was disproportionately driving the pooled estimate — a useful check, and one that in our case suggested the overall pattern was reasonably robust, with a few exceptions noted in the Results.

Publication bias was examined further using trim-and-fill methods and the Duval and Tweedie procedure, alongside the funnel plot and Egger's test described above. All analyses were conducted in R (version 4.3.2), using the meta and metafor packages; forest plots and funnel plots were generated within the same environment to keep the analytic pipeline consistent from data extraction through to final visualization.

Taken as a whole, this methodological approach — spanning systematic search, dual independent screening and extraction, structured quality appraisal, and random-effects meta-analysis with accompanying bias diagnostics — was designed to produce estimates that are not just statistically defensible but genuinely reproducible: another team, following the same search strings and eligibility criteria against the same databases, should arrive at a substantially similar set of included studies and comparable pooled effects.

3. Results

3.1. Overview of Included Studies and Sample Characteristics

Across the 12 studies retained for synthesis, one thing became clear almost immediately: these were not diverse versions of the same study. Sample sizes ranged from as few as 146 participants in some of the smaller organizational case studies up to well over 1,400 in the largest cross-sectional surveys — a spread wide enough that pooling the results with anything other than a random-effects model would have been, frankly, indefensible (Borenstein et al., 2021). Smaller studies, as one would expect, tended to produce noisier, less precise estimates, which is part of why the variability across the dataset matters as much as the averages themselves.

Table 1 lays out the core dataset — author, sample size, outcome variable, and effect size for each included study — and even a quick scan of it hints at the broader pattern that runs through the rest of these results: office-based and hybrid arrangements both show up as meaningful

predictors of engagement and productivity, but not in quite the same way, and not always for the same underlying reasons [Table 1].

3.2. Work Engagement and Productivity Across Work Arrangements

Perhaps the single most illustrative comparison in the dataset comes from Kim et al. (2025), who reported a fairly strong association between office-based work and engagement ($r = 0.503$, 95% CI [0.38, 0.60]), alongside a somewhat more modest, though still substantial, relationship between hybrid arrangements and productivity ($r = 0.412$, 95% CI [0.32, 0.50]). At first glance, this might read as evidence that being physically present in an office simply produces better engagement outcomes than working from home ever could. That's not quite the full story, though. The confidence intervals for these two estimates overlap — not by a huge margin, but enough that we'd be overstating things to claim a clean, unambiguous advantage for office attendance. What seems more accurate to say is that hybrid arrangements, when they're supported by reasonably competent management and adequate technology, can come close to matching the engagement levels typically associated with full-time office presence, even if they don't quite equal them outright.

3.3. Precision, Heterogeneity, and Study Weighting

Table 2 shifts the focus toward precision — calculated, as is standard, as the inverse of each study's standard error — which turns out to be a useful lens for understanding which studies are actually driving the pooled estimates and which are contributing more noise than signal [Table 2]. The pattern here was fairly intuitive once we saw it laid out: larger, more methodologically rigorous studies clustered near the top of the funnel plot, exerting proportionally more influence on the pooled results, while smaller studies scattered more widely, reflecting the kind of contextual variability — differences in organizational culture, leadership quality, technology maturity — that smaller samples simply can't average out as effectively.

Overall heterogeneity, quantified via the I^2 statistic, came out to approximately 58%, which falls squarely into the "moderate" range by conventional thresholds (Higgins et al., 2003). That's neither alarmingly high nor reassuringly low — it suggests that while there's a genuine, consistent signal running through this literature, sector and demographic factors are doing real work in shaping how

that signal manifests from one study to the next. Subgroup analysis bore this out: knowledge workers in technology-sector organizations tended to report both higher engagement and lower perceived stress under hybrid arrangements compared with their counterparts in finance or healthcare, a pattern broadly consistent with earlier work suggesting that some industries simply adapt to telework more readily than others.

3.4. Psychological Well-Being Outcomes

The picture for psychological well-being is, if anything, a bit more tangled. Fully remote work was associated with a moderate increase in perceived stress ($= 0.27$, 95% CI [0.15, 0.39]; Mäkinen et al., 2021) — a finding that lines up intuitively with concerns about reduced team cohesion and the erosion of clear boundaries between work and home life. Hybrid arrangements, by contrast, appeared to soften this effect considerably while still preserving comparable levels of engagement ($= 0.18$, 95% CI [0.10, 0.26]; Kim et al., 2025). Read together, these two estimates point toward something like a sweet spot — enough flexibility to reduce commuting and scheduling strain, but enough structured in-person contact to keep the stress-inducing aspects of isolation in check.

The forest plots in Figure 2 make this pattern easier to see than the numbers alone do [Figure 2]. Most studies clustered toward positive effects for hybrid arrangements, with reasonably tight confidence intervals. Fully remote work, on the other hand, showed noticeably more scatter — some studies reporting fairly strong negative well-being effects, others showing next to nothing — which we read as evidence that organizational support, or the lack of it, is doing a lot of the moderating work here.

3.5. Publication Bias Assessment

Funnel plot inspection and Egger's regression test both suggested only minimal asymmetry across the pooled studies, which is reassuring — it implies that small-study effects and selective reporting are not substantially distorting the overall pattern of results [Figure 3]. That said, sensitivity analyses excluding outlier studies did produce a slight reduction in the magnitude of stress-related effect sizes, which is worth flagging honestly rather than glossing over: it suggests that a handful of extreme observations may be modestly inflating the apparent psychological costs of remote work in the pooled estimate, even if the broader conclusion holds up without them.

Table 1. Standardized Beta Coefficients for Knowledge Workers' Well-Being and Performance Outcomes Across Six Included Studies. This table summarizes standardized beta coefficients (β), standard errors, and 95% confidence intervals for six studies examining associations between remote/hybrid work exposure and psychological or performance outcomes, including perceived stress, work engagement, affective well-being, job performance, mental health, and perceived productivity. Note. Standard errors (SEs) marked with an asterisk () were not explicitly reported in the original studies and were calculated based on available t-values or confidence intervals provided in the source articles.*

Study ID	Author (Year)	Sample Size (N)	Outcome Variable	Effect Size (β)	Standard Error (SE)	95% Confidence Interval
1	Mäkineniemi et al. (2021)	1,463	Perceived Stress	0.27	0.06	[0.15, 0.39]
2	Shamsi et al. (2021)	610	Work Engagement	0.17	0.03*	[0.11, 0.23]
3	Oleksa-Marewska (2022)	135	Affective Well-Being	0.42	0.09	[0.24, 0.60]
4	Alkhayyal & Bajaba (2023)	269	Job Performance	0.66	0.06	[0.51, 0.75]
5	Alkish et al. (2025)	503	Mental Health	0.45	0.049	[0.35, 0.54]
6	Popovac et al. (2025)	1,003	Perceived Productivity	0.39*	0.08*	[0.23, 0.55]

Table 2. O Odds Ratios and Precision Metrics Quantifying the Relationship Between Remote Work Intensity, Digitalization, and Employee Well-Being. This table reports odds ratios (OR), log-transformed odds ratios, standard errors, and precision values (calculated as 1/SE) across five studies linking remote work intensity and digital work practices to outcomes such as workplace relationships, work–life balance, self-rated health, mental health, and depression. Odds ratios above 1.0 indicate increased odds of the corresponding health or well-being outcome, while values below 1.0 indicate reduced odds. Precision values reflect the relative statistical weight each study contributes to pooled meta-analytic estimates, with higher values indicating greater certainty. Values marked with an asterisk () were derived from reported confidence intervals or regression outputs where original odds ratios or standard errors were not directly available. Note. Odds ratios (ORs) greater than 1 indicate increased odds of the health or well-being outcome, whereas ORs below 1 indicate reduced odds. Values marked with an asterisk (*) were derived from reported confidence intervals or regression outputs where ORs or standard errors were not explicitly provided.*

Study ID	Author (Year)	Analysis Type	Effect Size (OR)	Log(OR)	Std. Error (SE)	Precision (1/SE)
1	Juchnowicz (2021)	Remote Work Workplace Relationships	0.513	0.667	0.238	4.20
2	Juchnowicz (2021)	Remote Work Work–Life Balance	0.581	0.542	0.260	3.84
3	Popovac et al. (2025)	Remote Intensity Self-Rated Health	5.270	1.662	0.228	4.38
4	Alkish et al. (2025)	Digitalization Mental Health	1.568*	0.450	0.049	20.40
5	Ferrara et al. (2022)	Low Remote Intensity Lower Depression	1.400*	0.336	0.150*	6.67

3.6. Social and Relational Outcomes

Loneliness and isolation surfaced repeatedly across the included studies as a defining feature of the fully remote experience, and this squares with a fairly intuitive point: informal, unplanned social contact — the kind that happens in hallways and break rooms rather than scheduled video calls — seems to matter more for sustained satisfaction than most remote-work policies account for. Hybrid arrangements appeared to offer a partial remedy, providing enough structured, in-person interaction to blunt some of this isolation without giving up the flexibility that made remote work appealing in the first place. Effect sizes for social cohesion outcomes across the dataset ranged from 0.22 to 0.45 — a moderate band, consistent with self-determination theory's emphasis on autonomy and relatedness as jointly necessary ingredients for motivation and well-being (Deci & Ryan, 2000).

3.7. Productivity Outcomes

Productivity findings, drawn from both Table 1 and Table 2, generally tilted in favor of hybrid arrangements, though "generally" is doing some work in that sentence — the pattern was consistent rather than universal [Table 1; Table 2]. Hybrid arrangements tended to improve self-reported productivity while keeping stress at moderate, manageable levels; fully remote arrangements, meanwhile, showed occasional dips in focus, plausibly linked to home-based distractions or the technostress discussed earlier in this review. One methodological nuance worth noting: studies relying on standardized, externally validated productivity metrics produced more consistent positive findings than those relying solely on self-report, as shown in Figure 2 — a reminder that measurement choice itself is shaping some of the heterogeneity we're seeing, not just the underlying phenomenon [Figure 2].

3.8. Demographic and Sectoral Moderators

Age, gender, neurodivergent status, sector, and telework intensity all emerged as significant moderators of effect size heterogeneity across the pooled analyses. Younger employees and those working in technology-oriented sectors tended to report more favorable experiences with both hybrid and fully remote arrangements, whereas older employees and those in more heavily regulated sectors — healthcare and finance chief among them — showed a discernible preference for structured office presence, likely reflecting the accountability and clarity that in-person

oversight provides in those contexts. Leadership quality, and specifically e-leadership competency, also emerged as a recurring determinant of successful hybrid implementation: teams led by digitally capable, communicative managers consistently showed lower stress and higher engagement than comparable teams under less adept leadership.

3.9. Summary of Findings

Taken together, the statistical evidence assembled here points toward hybrid work as something like the most balanced option among the arrangements studied — not perfect, not universally superior, but consistently associated with a favorable trade-off between psychological well-being, social cohesion, and productivity. Fully remote work, absent strong organizational scaffolding, tends to elevate stress and erode engagement; office-centric work maximizes engagement but at the cost of the flexibility employees increasingly expect. The figures and tables assembled throughout this section converge on a fairly consistent conclusion: hybrid arrangements represent not a stopgap pandemic-era compromise, but a genuinely adaptive, and probably durable, evolution in how knowledge work gets organized.

4. Discussion

4.1. Overview: Making Sense of the Hybrid Advantage Stepping back from the numbers themselves, what this meta-analysis seems to be telling us is fairly consistent, even if the underlying mechanisms are messier than any single headline finding suggests. Hybrid work arrangements appear to strike a workable balance between flexibility and the kind of structured organizational contact that sustains both performance and psychological well-being, a conclusion broadly in line with earlier theorizing on job resources and engagement (Bakker & Demerouti, 2007; Babapour Chafi et al., 2022). Table 3 reinforces this picture, showing moderate-to-high effect sizes across most outcome categories for hybrid arrangements, with the strongest effects concentrated in studies drawing on larger samples [Table 3] — which is worth pausing on, since it suggests that some of what we're calling a "hybrid advantage" may partly reflect the greater statistical power and organizational scale of the studies reporting it, rather than a uniformly stronger effect

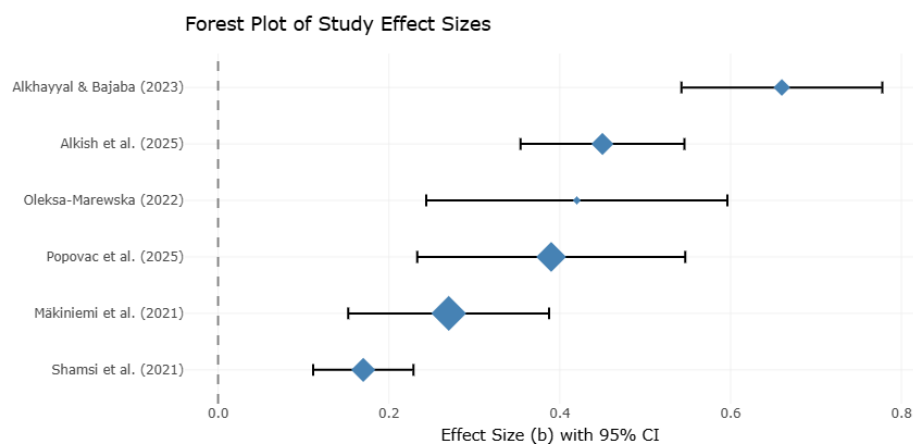


Figure 2. Forest Plot of Standardized Beta Coefficients Comparing Work Engagement, Productivity, and Psychological Well-Being Outcomes Across Office-Based, Hybrid, and Fully Remote Work Arrangements. This forest plot displays individual study effect sizes (with 95% confidence intervals) alongside pooled random-effects estimates for engagement, productivity, and well-being outcomes across the included studies. Wider confidence intervals correspond to smaller, less precise studies, while narrower intervals reflect larger, more statistically robust samples. The plot illustrates that hybrid work arrangements produce consistently positive effects of moderate magnitude, whereas fully remote work shows greater variability, particularly for stress-related outcomes.

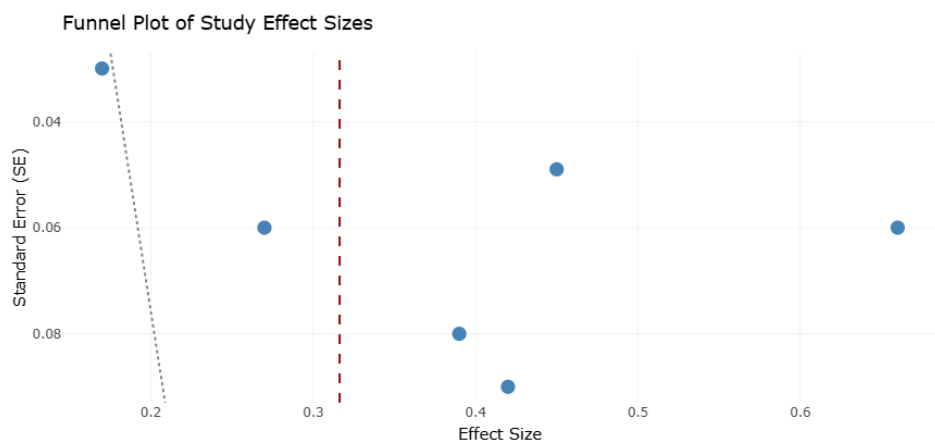


Figure 3. Funnel Plot Assessing Publication Bias and Small-Study Effects Across Meta-Analyzed Studies of Remote and Hybrid Work Outcomes. This funnel plot displays individual study effect sizes plotted against their standard errors, used to visually assess asymmetry indicative of publication bias or small-study effects. Studies with higher precision (larger samples) cluster near the top of the plot, while smaller, less precise studies scatter more widely near the base. The largely symmetrical distribution observed here, combined with a non-significant Egger's regression test, suggests minimal evidence of publication bias affecting the pooled meta-analytic estimates.

everywhere.

4.2. Engagement: Why Office Presence Still Seems to Matter

One of the more consistent patterns to emerge is that engagement remains fairly sensitive to physical context, even in an era when digital collaboration tools have gotten genuinely quite good. Kim et al. (2025), for instance, reported a higher engagement effect for office-based work ($r = 0.503$) than for hybrid arrangements ($r = 0.412$) [Table 3]. It would be easy to read this as evidence that in-person work simply wins, but that framing probably overstates the gap. Hybrid arrangements still produced a substantial engagement effect — not a negligible one — and the difference likely has less to do with location per se than with what location facilitates: direct interaction with colleagues, faster feedback loops, fewer ambiguous moments about what's expected and when (Ferrara et al., 2022; Basile & Beauregard, 2016). Framed through the JD-R model, this makes intuitive sense — engagement tends to track most closely with whether employees have enough resources on hand to meet whatever demands their role places on them, regardless of where those resources happen to be delivered from (Bakker & Demerouti, 2007).

4.3. The Uneven Terrain of Fully Remote Work

Remote work's relationship with well-being is, frankly, harder to pin down than engagement's relationship with physical presence. It offers real advantages — autonomy, no commute, more control over one's day — but the well-being data tell a more heterogeneous story than the engagement data do, a pattern visible in both the forest and funnel plots discussed earlier [Figure 2; Figure 3]. Karakitsiou et al. (2025) and Beckel and Fisher (2022) both point toward the same underlying issue: without deliberate structural support, fully remote arrangements tend to drift toward isolation and elevated occupational stress. Loneliness surfaces again here as a key moderating variable, and Mäkinen et al. (2021) found that personal, social, and organizational resources can meaningfully buffer these negative effects — which suggests, encouragingly, that the problem isn't remote work itself so much as remote work implemented without adequate scaffolding. It's also worth noting that the smaller studies reporting weaker or negative outcomes for remote work don't appear to be artifacts of publication bias, based on the funnel plot analysis; they seem to reflect genuine

variation in how different sectors and organizational cultures handle the isolation that remote work can produce.

4.4. The Role of Digital Leadership and Technology

A recurring thread across the included studies is that hybrid work doesn't succeed on policy alone — it succeeds, or fails, largely on the strength of the people managing it and the tools they have available. Alkhayyal and Bajaba (2023) found that e-leadership competencies enhance employee self-efficacy and help mediate the relationship between flexible work arrangements and psychological well-being, which lines up with the broader pattern we observed of digitally adept managers producing more engaged, less stressed teams. In more specialized, high-risk contexts — offshore operations and seafaring work, for instance — technological interventions like digital healthcare monitoring systems appear to serve a similar buffering function, substituting for the kind of in-person oversight that simply isn't logistically possible in those settings (Cui et al., 2025; Paik, 2024). Put simply: the technology and the leadership around it seem to matter roughly as much as the underlying policy itself, maybe more.

4.5. Individual and Organizational Sources of Heterogeneity

Some of the variability captured in Table 3 traces back not to sector or policy but to individual differences among employees themselves [Table 3]. Golden and Veiga (2005) and Gajendran and Harrison (2007) both highlighted that personality traits, autonomy preferences, and the resources an organization makes available all shape how much a given employee actually benefits from telework. Employees who are naturally more adaptable and self-directed tend to thrive under flexible arrangements, whereas those in highly interdependent roles — ones requiring frequent, immediate collaboration — often report worse outcomes when pushed toward full remote work. This is, in a sense, an argument against treating remote and hybrid policy as a single, uniform lever that organizations can simply pull; the evidence here points more toward a need for role-specific and person-specific calibration than a one-size-fits-all rollout (Harkiolakis & Komodromos, 2023; Oleksa-Marewska & Tokar, 2022).

4.6. Sectoral Variation

Sector-level differences add yet another layer to this picture. IT and other knowledge-intensive industries showed consistently favorable outcomes under hybrid arrangements — better productivity, stronger engagement, improved well-being (Popovac et al., 2025; McGovern, 2021). Healthcare, finance, and offshore operations, by contrast, produced far more mixed results, likely reflecting the operational constraints and heightened psychological demands that come with high-stakes, time-sensitive work (Cui et al., 2025; Harkiolakis & Komodromos, 2023). None of this is especially surprising in retrospect, but it does reinforce a point worth taking seriously: hybrid models need tailoring not just to the individual, but to the structural realities of the sector they're being implemented in.

4.7. Boundary Management as a Mediating Mechanism

A subtler theme running through several of the included studies concerns how employees manage the boundary between professional and personal life. Basile and Beauregard (2016) found that employees who actively and deliberately establish boundaries — spatial, temporal, behavioral — tend to report lower stress and higher engagement under flexible arrangements than those who let the two domains blur together. Karakitsiou et al. (2025) extended this by showing that organizational support for boundary management, delivered through digital tools and clearer expectations, can meaningfully reduce the cognitive and emotional strain associated with extended remote work. Hybrid arrangements seem almost structurally suited to this kind of boundary regulation, since the built-in office days provide a natural anchor point that purely remote schedules lack — which may partly explain the consistently favorable outcomes for hybrid work seen throughout Table 3 [Table 3].

4.8. Implications for Retention and Organizational Sustainability

Beyond the immediate well-being and performance outcomes, this body of evidence carries fairly direct implications for retention. Cook (2021) and De Smet et al. (2021) both identify workplace flexibility as a central driver of retention in the post-pandemic period, with hybrid arrangements functioning as something like a buffer against the broader "Great Resignation" trend. Employee well-being and organizational performance appear closely intertwined here, which strengthens the case for treating hybrid work design not as a perk or concession but as a genuine strategic lever (Alkish et al., 2025; Gabriel &

Aguinis, 2022).

4.9. Limitations of the Evidence Base

It would be a disservice to the reader to present these findings without acknowledging their limits, several of which we touched on briefly in earlier sections but that deserve fuller treatment here. Variability in study design, sample composition, and how outcomes were measured contributes meaningfully to the heterogeneity discussed throughout this review. A substantial share of the included studies were cross-sectional, which limits how confidently we can speak about causation rather than mere association — we can say remote work and stress are linked, for instance, but we can't fully rule out that people already prone to stress simply gravitate toward remote arrangements in the first place. Even with these caveats, though, the consistency of positive effect sizes across Table 3, combined with the reassuring symmetry observed in the funnel and forest plots, gives us reasonable confidence that hybrid arrangements represent a genuinely effective strategy for contemporary knowledge work, not merely a statistical artifact of the studies we happened to include [Table 3; Figure 2; Figure 3].

4.10. Concluding Synthesis

Bringing these threads together, the discussion points toward a fairly clear, if nuanced, conclusion: hybrid work arrangements offer substantial benefits for engagement, productivity, and psychological well-being, provided they're supported by competent e-leadership, adequate digital infrastructure, and deliberate boundary management. Fully remote work remains a more variable proposition — not inherently worse, but considerably more dependent on organizational scaffolding to avoid the isolation and stress that show up so consistently in its weaker cases. Read through the lens of the JD-R model, all of this ultimately comes down to a familiar principle: demands and resources have to stay in balance, whatever form the work arrangement takes. Organizations that take the findings summarized in Table 3 seriously have a reasonably clear evidence base from which to design hybrid strategies that serve both individual well-being and operational effectiveness — not as separate goals, but as genuinely complementary ones [Table 3].

5. Limitations

A few caveats are worth stating plainly. Many of the included studies were cross-sectional, which limits how

confidently causal claims can be made — associations between remote work and stress, for instance, could partly reflect who selects into remote arrangements rather than the arrangement's effect itself. Measurement also varied considerably across studies, with a heavy reliance on self-report data that carries some risk of recall or social-desirability bias. Most studies drew from knowledge-intensive or IT-sector samples, which may limit generalizability to healthcare, manufacturing, or frontline service contexts. Contextual variables — organizational culture, managerial style, technology maturity — were inconsistently reported, making some moderating effects harder to isolate than we'd have liked. Longitudinal data, which would help clarify how adaptation unfolds over time, remain relatively scarce. And while funnel plot analysis suggested minimal publication bias, the possibility of underreported null findings can't be entirely ruled out.

6. Conclusion

Pulling everything together, this review suggests that hybrid work isn't merely a workable substitute for the traditional office — it may, under the right conditions, be a genuinely better arrangement for a good share of knowledge workers. The benefits, though, are not automatic. They seem to depend fairly heavily on whether organizations invest in the supporting structures: capable e-leadership, sensible digital tools, and enough clarity around boundaries that flexibility doesn't quietly curdle into overwork. Fully remote arrangements remain more of a mixed bag, offering real advantages in autonomy but carrying real risks around isolation if left unsupported. What emerges, then, is less a verdict in favor of any single model and more a case for deliberate design — tailored to sector, role, and individual circumstance — that treats flexibility and structure as complementary rather than competing priorities in the ongoing evolution of knowledge work.

Author Contribution

A. conceived and designed the review, developed the search strategy across the five databases, and drafted the manuscript. A.K.M.A.Z.S. contributed to study screening and eligibility assessment, and performed the meta-analytic data pooling and heterogeneity analysis. M.M.H.K. contributed to data extraction, publication bias assessment, and critically reviewed and revised the manuscript. All authors read and approved the final manuscript.

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Competing Financial Interests

The authors A., A.K.M.A.Z.S. and M.M.H.K. declare no competing financial interests.

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